

ing gales indicated for Florida coasts, and northeast gales as far north as Norfolk.

By the evening of October 1 the storm center had moved to a position about 150 miles to the northeastward of Jupiter and was apparently moving in a northwesterly direction. During the night of October 1 the storm was deflected to a more westerly course by an extensive area of high barometer which occupied the Atlantic coast districts to the northward of its position, and, following a law previously referred to, it increased in intensity, until, by the morning of October 2, when it was central off the coast northeast of Jacksonville, Fla., it had acquired hurricane strength. Immediately following the receipt of the morning reports on October 2, the following message was telegraphed to all south Atlantic ports and to the Navy Department, the maritime exchanges, and all interests, both marine and land, which were subject to injury by hurricanes:

Hurricane off the northeast point of Florida will move north and cause northeast hurricane winds on the South Atlantic coast this afternoon, and to-night on the Middle Atlantic coast.

Advisory messages were sent to middle and east Gulf coasts, and all authorized means were used to disseminate throughout the threatened districts information regarding the hurricane. The storm center crossed the coast line about midway between Jacksonville and Savannah, in the neighborhood of 11 a. m. of October 2, and the character of its action during that day is indicated by the following reports:

A. J. Mitchell, section director, Weather Bureau, Jacksonville, Fla.:

The barometer fell rapidly during the day and night of October 1, and reached a minimum of 29.07 at 11 a. m. of the 2d. The storm center appeared to pass north and east of Jacksonville, probably 50 to 60 miles distant. The maximum wind velocity, 60 miles an hour, occurred about 11:10 a. m., 2d. Information signals were hoisted at 1 p. m., of the 1st, and northeast storm signals were displayed at 4 p. m. of the 1st, and at 7 a. m. of 2d hurricane signals were hoisted. As the storm approached from the southeast no serious damage was done to coast districts south of Mayport; at Mayport and Pablo flood damages amounted to several thousand dollars. In Jacksonville damages will not exceed \$5,000, the small loss being due, in a great measure, to the timely warnings of the Bureau, and also to the fact that the highest winds were from a westerly direction. The coast district from Mayport to Fernandina suffered heavily, in fact Fernandina was nearly destroyed. Great damage was caused on the coast near and south of Everet. On the south Georgia coast the wind was from the northeast, and the sea flooded level lands, destroying crops and stock and imperiling lives. From Savannah to St. Augustine all telegraph lines were prostrated and many miles of railroad track washed away. At Fernandina boats at anchor foundered or were blown into the marshes. A conservative estimate of the damage in Florida by this storm is \$500,000.

It is a pleasure to report that the Bureau effectively reduced the losses of both property and life by warnings. Vessels that would have sailed Saturday from the several Florida ports numbered ten or more, and, as they were sailing craft, they would have suffered the fate of those caught at sea. The value of the vessels and cargoes detained was \$380,000, and the crews numbered 56.

H. B. Boyer, Observer, Weather Bureau, Savannah, Ga.:

The most of the damage sustained in the vicinity of Savannah was caused by the backing up of the water by the southeast hurricane winds blowing against the Gulf Stream. Cotton warehouses and naval stores yards were flooded to a depth of several feet, and merchandise stored under sheds was damaged by heavy rain. It is impossible to make an estimate of the loss along the city wharves, but it was quite heavy. About 5,000 barrels of rosin were floated and badly scattered, and it is estimated that 60,000 bushels of rice, valued at about \$60,000, were washed away. The conditions along the Ogeechee were fully as bad as along the Savannah. Mr. W. G. Morrill, who represents three-fourths of the rice planting interests in this section, stating that his losses from the two storms (August 30-31 and October 1-2) amounted to \$350,000, which represents value of life and live stock destroyed. He also states that 97 negroes were drowned upon the plantation which he represents.

Hutchinsons Island, opposite Savannah, was completely overflowed to a depth of 4 to 8 feet, the salt water stretching back over the rice plantations in South Carolina to the pine ridges, about 3 miles to the northeast of Savannah. All the lowland to the eastward of Savannah was submerged.

At Thunderbolt, about 6 miles from Savannah, and on the Wilmington River, one life was lost. Small sailing craft were sunk or blown into the marshes, and wharves were damaged; the property loss being estimated at \$3,000 to \$5,000. At the Isle of Hope the water rose 15 feet, washing away bath-houses and boat-houses. Down the Savannah River wharves and oil houses were washed away. At Quarantine station the wharves were badly damaged, and the British steamer *Syanara*, and the schooners *Fannie L. Childs* and *Millville*, and the Italian bark *Franklyn* were blown ashore. The loss to wharves and tramway was \$3,500. At Tybee Island Mr. Lovell's house was blown away, and at the fort about 24 feet of sand piled up inside the works. The Tybee railroad was badly washed. At Warsaw the barracks were washed out, and a depth of 4 feet of water was reported in the magazine. The Sea Islands off the Carolina coasts escaped severe injury, although the tide was very high and the wind heavy. At Beaufort the water came up into the streets. At Port Royal, S. C., the damage was slight. At the naval station considerable sand was washed into the dry dock. The greatest loss was sustained south of Savannah and nearer the storm center. Great havoc was caused at Brunswick, where a conservative estimate places the losses at \$500,000. Nearly every business house and warehouse in the city was flooded. At noon, on the 2d, the principal residence and business thoroughfares were 4 to 8 feet under water. Nearly all docks suffered from lifting; one to two hundred thousand feet of lumber and hundreds of barrels of naval stores were washed away, and five vessels were washed ashore. At New Town, records kept by the family of Egbert Dart, show that not since 1812 has such a flood been known in that section.

Campbell Island, 12 miles from Darien, on the Attahama, was swept by water, and all of its inhabitants, except three, were drowned—not less than 20 and perhaps 50. At Darien there were 31 persons drowned and 1 killed, and the loss to rice, stock, lumber, vessels, etc., aggregated \$350,000. The height of the tidal wave at that place was about 13 feet above mean high water mark, inland, and 18 feet at Sapels Light-house.

The property damaged at Brunswick, Darien, and the surrounding country, is estimated at \$1,000,000, and the loss in the State is incalculable.

At Savannah the information signal was ordered at 10:20 a. m. of October 1, and storm northeast signals at 4:30 p. m. Every effort was made to disseminate the warnings. The storm winds began 2:30 a. m. of September 2, and continued until 11:50 p. m. of that date, with a maximum velocity of 60 miles per hour from the northeast at 11:30 a. m. No damage was sustained by the shipping in port. The Savannah Morning News of October 3 remarked as follows in connection with the work of the Weather Bureau: "To these (Weather Bureau) warnings the safety of the shipping in the harbor was due. \* \* \* Every precaution had been taken to warn shipping circles and considerable damage was averted by the advice from the Capital."

Mr. Boyer cites many highly commendatory statements by representatives of the maritime and business interests of Savannah and vicinity, wherein a saving of many thousands of dollars is shown to have resulted from precautionary measures, which were based upon advices received from the Weather Bureau.

L. N. Jesunofsky, Local Forecast Official, Charleston, S. C.:

The order to hoist storm northeast signals was received 6:07 p. m. 1st, and the information the accompanying message contained regarding the approaching storm was given the widest distribution. Very little damage was caused in Charleston and vicinity, although damage was caused to sailing craft and a number of persons were drowned along the South Carolina coast.

Mariners were all warned on Saturday, the day preceding the storm, that navigation would be dangerous within the following forty-eight hours, and vessels and cargoes to the value of nearly \$1,000,000 were detained in port, and many tugs, schooners, barks, brigs, and steam vessels were taken up the Ashley and Cooper rivers late Saturday and early Sunday to avoid the high seas. Rice planters lost heavily from the high tides, and the sea-island cotton growers had their crops injured by sea spray.

After the 2d the storm passed inland and lost force rapidly.

#### FROST WARNINGS.

The morning of October 21 warnings of frost were telegraphed to points in Texas, Louisiana, Arkansas, Mississippi, Alabama, western Tennessee, western Kentucky, and the interior of western Florida, and on the morning of October 22, 1898, reports warranted the issue of the following special bulletin from the Central Office at Washington:

This morning's reports show frosts generally throughout the infected

district. In Alabama, eastern and northern Mississippi, and northern Louisiana the frosts were heavy and killing; in southwestern Mississippi and southern Louisiana light frost was reported. At Mobile the minimum temperature was 40°, and at New Orleans 46°, the lowest previous record for the third decade of October being 34°, at Mobile, and 42° at New Orleans. November 18 is the earliest date on which freezing temperature has ever occurred at New Orleans, and November 2 is the earliest date of freezing temperature at Mobile.

In central Mississippi and northern Louisiana, and also in northern Alabama and northern Georgia freezing weather has occurred in the third decade of October. The earliest date of heavy frost at Mobile was November 2, 1874-1878. The earliest date of heavy frost at New Orleans was November 11, 1877.

The first heavy frost has occurred as late as December 29 at Mobile, while at New Orleans November and December have in a number of years failed to show the occurrence of heavy frost. The average date of first heavy frost is November 22 at Mobile and December 7 at New Orleans.

The average minimum temperatures for the region referred to range from 50° to 55° during November, with occasional periods of freezing temperature.

The occurrence of light frost Tuesday morning, supplemented by heavier frosts and lower temperature this morning, may be considered unfavorable for the further progress of the disease. Present conditions indicate frost, and temperature 40°, or slightly below, to-night in Alabama, Mississippi, and in the interior of Louisiana. The temperature will probably remain for several days below the seasonal average, which is 66° at New Orleans and 65° at Mobile.

Acting upon the information contained in this bulletin, Edmond Souchon, President of the Louisiana Board of Health, issued the following proclamation, October 22, 1898:

Whereas, the Weather Bureau reports frosts occurring all over the State, and, whereas, it is a fact accepted by epidemiologists that no foci of yellow fever can be established in any place after frost is shown; therefore, be it ordained that all quarantine restrictions on traffic are hereby removed by the Louisiana State Board of Health, as far as it is concerned.

#### THE CHICAGO FORECAST DISTRICT.

Two storms of marked intensity caused dangerous gales over the upper lakes during the month. The first developed in the middle Mississippi Valley on the night of the 16-17th and remained nearly stationary for forty-eight hours. During the 17th and 18th the following maximum wind velocities occurred: Chicago, 63 southeast; Milwaukee, 40 south; Alpena, 38 southeast; Sault Ste. Marie, 38 southeast.

Storm signals were hoisted at all upper-lake ports at 9:30 a. m., October 17, giving ample warning of the gale.

The second storm was centered over northern Illinois the morning of the 25th, and it moved northeastward over lower Michigan during the succeeding twenty-four hours. The storm was attended by northerly gales, resulting in considerable damage to shipping on Lake Michigan and destroying much property along the shore in Chicago. The following maximum wind velocities occurred: Chicago, 48 north; Milwaukee, 40 north; Green Bay, 36 north; Marquette, 30 north. The wind forecast for the upper Lakes on the morning of the 24th was as follows:

Lake Superior, brisk and possibly high northerly winds; lakes Michigan and Huron, brisk and possibly high southerly winds, shifting on Michigan to northerly this afternoon or to-night and on Huron Tuesday morning.

Moreover, vessel masters leaving the port of Chicago during the afternoon and evening of the 24th were cautioned that strong northerly winds would be encountered farther down the lake. Some remained in port, while others proceeded on their way, intending to seek shelter in some harbor on the west shore as soon as the storm should strike. Storm signals were ordered up at all ports on the 25th, at 10:30 a. m., except Duluth, Chicago, and Grand Haven sections, the two latter being ordered at 3:30 p. m. The force of the storm was really centered over Lake Michigan, and the forecast for that lake, issued the morning of the 25th, was as follows:

Winds shifting to brisk and high northerly, probably becoming dangerous; rain to-night, possibly turning to snow flurries.

Although the maximum wind velocity from the southeast at Chicago on the 17th exceeded that from the north on the 25th by 15 miles per hour, there was no appreciable damage to shipping or property at the southern end of Lake Michigan during the former storm, yet on the 25th the tremendous sea, caused by the northerly on shore gale, wrought great havoc. It is also interesting to note that both these storms developed from long drawn out troughs of low pressure, which were apparently without distinct centers twelve hours previous to their development.—*H. J. Cox, Forecast Official.*

The following report of the storm of October 25 and 26 was made from Milwaukee on October 31, to the Secretary of Agriculture by the Chief of the Weather Bureau:

This storm stranded one vessel on the beach at Chicago, one at Milwaukee, another at Michigan City, Ind., and totally destroyed the steamer *Doty* off Racine, her crew of seventeen being lost. The Weather Bureau completely warned mariners of the coming of the storm by means of numerous messages distributed among the docks of all lake ports and by flag signals during the day and lanterns at night. I was in Chicago on Monday and personally supervised the action of Mr. Cox, who ordered the signals displayed. I make this statement because a rumor was started that the Bureau had failed to give warning of the storm. This rumor was quickly corrected by the press. I inclose a clipping from the Chicago Chronicle, and have marked a quotation from the statement of the cook on the consort of the *Doty*. This woman states that their vessel left Chicago harbor in tow of the *Doty* at a time when storm signals were flying.

I know of several vessel owners in Milwaukee who, in public, have congratulated themselves on the fact that they took heed of the warnings and ordered their craft held in port. It is probable that many scores of lives would have been lost, instead of seventeen, had not danger signals been displayed.

In this connection I desire to emphasize the fact that it is possible for a storm to strike the lake region without the Weather Bureau being able to give warning of the same, although such a condition has not occurred for a long time. Several times during my service of twenty years in the Weather Bureau I have seen storms develop in Iowa just after the regular observations were taken, and reach a few of the lake ports before warnings could be distributed. Happily such occurrences are rare.

#### SAN FRANCISCO FORECAST DISTRICT.

Rain warnings were distributed throughout the raisin drying district of California on the 1st, 7th, 21st, 22d, 29th and 31st, and to the fruit growing district north of Santa Cruz and Stockton on the 14th. All these warnings were fully verified. Although on one instance no rain fell at Fresno, showers prevailed throughout the greater portion of the San Joaquin Valley. There was no instance during this raisin drying season when rain occurred without warning, and no warning was issued without being fully verified. Probably 90 per cent of the crop was protected on account of the warnings, and the injury this year was very small indeed. The value of the crop probably amounts to \$2,500,000, which would possibly have been reduced one-half without the protection of the bureau, and might have been utterly destroyed.

#### RAIN FORECASTS.

Weekly Citograph, Redlands, Cal., October 15, 1898:

Warnings sent out by the Weather Bureau to the raisin and prune growers in the last two or three weeks gave ample time to stack and save their fruit. The saving to the growers is tremendous, much more than enough to pay the cost of the service for many months. When the farmer feels like kicking because some particular prediction does not happen to fit his particular ten-acre patch, just let him add his voice to the general clamor for more stations, because the more stations the more accurate the predictions can be made.

The warnings during the greater part of this month were issued by Mr. G. H. Willson, the writer being away on leave of absence.—*W. H. Hammon, Forecast Official.*

#### PORTLAND, OREG., FORECAST DISTRICT.

Signals were ordered up on October 12th, 13th, 16th, and 25th, and frost warnings were issued on the 3d, 15th, and